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EDITORIAL COMMENT

How to Optimize Left Main Percutaneous Coronary Intervention*

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As a result of the demonstrated survival benefit of coronary artery bypass surgery over medical treatment, and the unfavorable initial results of coronary balloon angioplasty, coronary artery bypass grafting (CABG) has been the standard care for significant left main coronary artery (LMCA) stenosis (1,2).

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Despite unfavorable outcomes in the early era of LMCA percutaneous coronary intervention (PCI), interventionalists have continued attempting percutaneous treatment for LMCA stenosis (3). Technical advances in PCI and stent technology, particularly with the widespread availability of drug-eluting stents (DES), have led physicians to re-evaluate the role of PCI as a viable alternative treatment for unprotected LMCA disease. As a result, during the last decade, the prevalence of LMCA stenting has significantly increased worldwide. In addition, several recent large registries and randomized controlled trials such as the MAIN-COMPARE (Revascularization for Unprotected Left Main Coronary Artery Stenosis: Comparison of Percutaneous Coronary Angioplasty Versus Surgical Revascularization) registry, SYNTAX (SYNergy Between PCI With TAXUS and Cardiac Surgery), and PRECOMBAT (PREmier of Randomized COMparison of Bypass Surgery Versus AngioplasTy Using Sirolimus-Eluting Stent in Patients With Left Main Coronary Artery Disease) randomized trials have demonstrated that LMCA stenting yields comparable mortality and morbidity rates to CABG (4–6). Currently, the PCI guideline for the elective treatment of LMCA stenosis has been updated to Class IIa, Level of Evidence: B depending on anatomic complexity of coronary artery disease (7). It is obvious that PCI has become more generally applicable to patients in elective situations beyond the very limited use in patients who are poor candidates for CABG.

In this issue of *JACC: Cardiovascular Interventions*, Almudarra et al. (8) used national data from the British Cardiovascular Intervention Society to report the clinical outcomes of 5,065 patients undergoing PCI of an unprotected left main stenosis in the United Kingdom from 2005 to 2010. Patients were categorized into 3 clinical syndromes: ST-segment elevation myocardial infarction (STEMI), non–ST-segment acute coronary syndrome (NSTEACS), or chronic stable angina (CSA). The investigators evaluated the outcomes as a function of clinical presentation. STEMI or NSTEACS patients, compared with CSA patients, had significantly higher mortality at 30 days (1.4% vs. 8.9% vs. 28.3%, respectively) and at 1 year (7.0% vs. 19.5% vs. 37.6%, respectively). Forty percent of the patients presented with cardiogenic shock. Mortality at 1 year after STEMI with cardiogenic shock was significantly higher than in STEMI without shock (65% vs. 30%). This study is of value as the first whole-country outcomes study of LMCA PCI and demonstrates that LMCA PCI is feasible in a variety of clinical presentations. Particularly, CSA patients composed 37.5% of the study population and showed very favorable clinical outcomes. However, several modifiable procedural factors need to be addressed to achieve better outcomes of LMCA stenting.

First, intravascular ultrasound (IVUS) was used in only 35.9% of CSA patients, which is lower compared with that reported in other studies (4,6). IVUS provides accurate information about stent sizing and helps to detect suboptimal stent deployment or stent-related complications, thereby making LMCA PCI safer and more effective. Previously, the MAIN-COMPARE registry, and more recently, the de la Torre Hernandez et al. (10) study, demonstrated that IVUS-guided LMCA stenting is associated with less mortality (9,10). Second, for the distal left main disease, the PCI strategy may affect the prognosis. In general, the single-stent technique clearly shows more favorable long-term clinical outcomes compared with the 2-stent technique, even in true bifurcation stenosis (11). Selection of a single- or 2-stent technique should be based on disease involvement and the territory supplied by the left circumflex ostium. IVUS provides accurate information for both main and side branch disease status and was helpful in the decision of treatment strategy. Therefore, more frequent selection of the single-stent technique guided by the IVUS may reduce the adverse events over time. Third, a pressure wire for fractional flow measurement (FFR) was used in only 12% of CSA patients. Traditionally, angiographic diameter stenosis of 50% has been considered a cutoff for significant LMCA stenosis (4–6). However, the conventional coronary

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angiogram has limitations in assessing functional severity of LMCA stenosis. In addition, noninvasive functional testing, such as a myocardial perfusion imaging, is often noncontributory in the diagnosis of patients with a LMCA stenosis. Therefore, direct measurement of FFR may be helpful in deciding whether to perform revascularization of LMCA stenosis, particularly ostial or shaft stenosis. Using this measure, unnecessary LMCA PCI could be avoided. Several studies already demonstrated that FFR-guided decision making for the treatment of LMCA is associated with favorable prognosis and the intermediate LMCA lesion with FFR = 0.75 to 0.80 could be safely deferred (12). In addition, for LMCA stenosis, if FFR measurement is not feasible, the IVUS minimal lumen area (= 4.8 mm^2) could be used as a definition of significant functional stenosis (13). Fourth, the DES implantation is of paramount importance in PCI for unprotected LMCA stenosis. In this cohort, they still used bare-metal stents in a substantial number of these patients. Although the LMCA itself appeared to be relatively resistant to restenosis because of its large caliber, PCI with bare-metal stents for distal left main bifurcation lesions or for the associated extra-LMCA disease has shown a high event rate. In fact, meta-analysis of observational studies and randomized controlled trials involving 10,342 patients with unprotected LMCA stenosis demonstrated significantly lower crude mortality and adverse event rates in DES-implanted patients than in those with bare-metal stents (14). In addition, the wide use of second-generation DES, which have been safer and more effective than first-generation DES, could further reduce the event rate of LMCA PCI in recent years (15).

Currently, another randomized trial comparing PCI with everolimus-eluting stents to CABG, using endpoints of death, myocardial infarction, and stroke (EXCEL [EXCEL Clinical Trial; Evaluation of XIENCE PRIME™ Everolimus Eluting Stent System (EECSS) or XIENCE V® EECSS or XIENCE Xpedition™ EECSS or XIENCE PRO EECSS Versus Coronary Artery Bypass Surgery for Effectiveness of Left Main Revascularization]) is in process. This trial adopted recent stent technology, a distal left main PCI strategy, and adjuvant techniques of IVUS and FFR, and thereby may further clarify the current status and role of PCI compared with CABG for significant LMCA stenosis.

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Key Words: chronic stable angina ■ mortality ■ multiple imputation ■ NSTEACS ■ outcome ■ percutaneous coronary intervention ■ STEMI ■ survival ■ unprotected left main stem.